Design of Collaborative Organization and On-Site Dispatching System for Multiple Water Rescue Forces

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Abstract. The coordinated dispatch of multiple rescue forces for water emergencies refers to the establishment of temporary institutions such as emergency headquarters, on-site emergency headquarters or emergency command centers by governments at all levels and relevant functional departments during emergency response and emergency disposal. "Intelligent emergency rescue under the framework is the goal, in accordance with the requirements of the established emergency management legal system, system and emergency plan, obeying certain command relations and dispatching principles, using certain command methods, and comprehensively coordinating rescue forces from all aspects. A series of activities to respond to and deal with security incidents. The coordinated dispatch of multiple rescue forces for water emergencies is formed into a system, and the intelligent technology of emergency rescue is used to achieve high-level data analysis, management and decision-making, and to realize intelligent analysis, intelligent dispatch, intelligent collaboration, intelligent generation and intelligent planning of emergency rescue. All-round management of emergency rescue such as equipment management, highlighting the ability of intelligent perception, intelligent transmission, intelligent processing and intelligent application of information. Based on the principles of lowest cost, least time-consuming, optimal power, lowest resource consumption, and efficient operation management, build an intelligent emergency rescue collaborative management platform with intelligent rescue and intelligent collaboration as the core elements, so that the intelligent emergency rescue management system has self-learning capabilities, self-induction, self-coordination and other functions, making the water emergency rescue operations safer, more reliable and more timely.

Keywords: Diversified Assistance; Wisdom Rescue; Rescue Intelligent Technology.

1. Research Background and Significance

1.1 Research Background

In recent years, with the development of my country's water transportation industry, the risk of water emergencies has increased, and the demand for water emergency rescue support technology has been increasing. According to incomplete statistics, the Yangtze River alone has 60-80 water traffic accidents every year, with about 5,000 people in distress, and offshore emergencies occur from time to time. The task of emergency command in our country is very heavy. The construction of emergency command and coordinated dispatch system is not only very important and urgent, but also quite difficult and long-term[1].

Water emergencies are likely to cause property damage and endanger the lives of the people, and have a great social impact. Some emergencies last for a long time, have a wide range of hazards, and are complicated to deal with. It is necessary to mobilize and coordinate multiple relevant departments and units, unified leadership, and active actions. Carry out rescue and resettlement work in a timely and effective manner[2]. A structured, networked and flat emergency command information system must be established in order to effectively deal with the response, to achieve timely prevention and rapid response. The emergency command and dispatch system plays an important role[3]. Nowadays, the core technology of emergency rescue still has a certain gap compared with foreign countries. With the development of emergency rescue technology and the increase of rescue equipment, higher requirements have been put forward for the coordinated dispatch of multiple rescue forces[1].

1.2 Project Research Significance

Through the construction of the coordinated dispatching system of multiple rescue forces, the problems of low level of informatization of water emergency rescue, comprehensive resource utilization ability, analysis and decision-making ability, comprehensive supervision and command and dispatching ability are comprehensively solved. Integrate rescue on-site environmental monitoring data and meteorological and hydrological forecast information, integrate rescue operation simulation system, expert system, digital plan system, scheme library system, standard and equipment library system, and adopt multi-task collaboration technology to provide accurate and reliable rescue operation plans. Coordinate scheduling of personnel, materials and equipment according to the operation plan[2]. The scientific decision-making of emergency rescue equipment management, the accurate monitoring of the rescue scene environment, the seamless coordination and linkage of rescue forces, the intelligent correlation analysis of personnel equipment and plans, and the real-time emergency rescue and other capabilities have been integrated into the research and development process of the collaborative dispatching system. To achieve the goal of fast, intelligent, safe and accurate water emergency rescue[3].

2. Research Status at Home and Abroad

2.1 Current Status of Foreign Research

In the United States, maritime search and rescue work has built an information platform for maritime search and rescue coordination and command, such as the COSPAS/SARSAT system, with the help of a modern information management system. In Japan, in order to respond to water emergencies and improve the information receiving and early warning mechanism for water dangers, shore-based radio stations have been set up along the coast to receive various types of maritime danger information in real time, and use satellite, short-wave communication and other communication means to determine the location of water dangers in time. In Canada, maritime search and rescue work is mainly through the installation of automatic identification systems, enhanced ship identification and tracking of ships approaching or sailing in Canadian waters.

2.2 Research State in China

With the widespread attention of emergency command and dispatch in my country in recent years, scholars in related fields have studied the emergency command of many domestic emergencies, and put forward suggestions and ideas for building a standardized on-site emergency command system in my country[4]. Liu Dan et al. analyzed the flood control on-site emergency command organization of the Three Gorges Reservoir and proposed a rigid and flexible composite, open and contingent on-site emergency command organization structure according to the floods in the entire Yangtze River basin in the Three Gorges region. Huo Yan designed the on-site emergency command system in big cities from the aspects of system overall, safety and application.

2.3 Comparison of Research Status at Home and Abroad

The construction of the emergency command platform and the configuration of the emergency command organization are the two basic areas of emergency command and dispatch. Organizational configuration is the foundation and premise of platform construction, but the current organizational configuration is more of a static-level institutional design that emphasizes prevention. There are many related studies on the design of emergency command platform, but the actual role of the platform in emergency response still needs to be further evaluated. In fact, the function of the emergency platform system also depends on the deployment mechanism of the emergency organization, and the effectiveness of the emergency platform technology also depends on the effectiveness of the authority operation mechanism of the on-site command system. The system constructed in this project is

dedicated to optimizing the power operation mechanism of the on-site command and dispatching system and improving organizational efficiency.

3. Project Innovation Point

The system runs the running status assessment application and real-time database on the same server, incorporates relatively independent subsystems into a unified information network, adopts a data distribution service model, realizes information integration, and builds a set of monitoring and control systems. , management in one network, information integrated platform system, can promote the real-time and efficient distribution of data[5].

By assigning different clients to different roles, this system improves the emergency rescue capabilities of relevant personnel through accident emergency simulation of the water transportation system, so as to ensure the safety of ship navigation, reduce ship accident losses, and improve ship transportation efficiency.

By comprehensively using multi-source sensor equipment to quickly detect underwater space, this system realizes the dynamic perception of the accident subject's spatial structure and rescue target position, which will help reduce the difficulty of rescue and formulate a scientific rescue plan.

4. Project Research Implementation Plan

4.1 Coordinated Planning and Design of the Coordinated Dispatching System of Multiple Rescue Forces

The use of unmanned equipment in water emergency rescue is increasingly in-depth, and the rescue continues to show a three-dimensional and multi-directional trend. Each rescue force (including rescue personnel and unmanned equipment) will undertake special tasks, thereby forming a collaborative network for task execution. . The degree of cooperation among various subjects will directly affect the overall effectiveness of emergency rescue, and the conditions restricting the execution of these tasks include information exchange, inter-task dependencies, and the decision-making and behavior of rescue subjects[6].

Coordinated dispatch of emergency rescue generally requires the participation of multiple geographically and functionally dispersed departments. Due to the difficulty of sharing global information, each participating department not only needs to plan its own emergency tasks according to the local emergency situation, but also needs to achieve all departmental tasks through reasonable coordination. Coordinated operation of planning programs is a multi-departmental collaborative task planning problem. During the response process, the dependencies between different emergency plans and actions are the trigger points for the collaboration process of different departments, and the dependencies between actions of different departments are managed through a coordination mechanism. The lack of effective coordination will lead to confusion and difficulty in information exchange among departments. Determine coordination results and program adjustment failures. In addition, in the process of emergency response decision-making, the coordinated use of emergency resources by different departments is very important to the execution of emergency tasks, especially the conflict relationship generated in the process of resource allocation, often resulting in the inability to meet the task resource requirements, resulting in the task of some departments. can not complete[7].

In response to the above problems, this project studies a multi-departmental coordination method for emergency resources based on hierarchical task networks. Finds algorithms for path task planning in the Collaborative Task Planning Framework job. Among them, the collaborative task planning framework based on the hierarchical task network makes the planning process and the coordination process alternate. In the process of local plan planning, each time a sub-action is generated, coordination with other departments is carried out to improve the generation efficiency of the overall plan; at the same time, in order to deal with For conflicts arising from the use of emergency resources

between tasks, a resource coordination mechanism is used in the coordination process to ensure their coordinated use.

The scheduling scheme of multiple rescue forces aims to provide dynamic rescue strategies, resource allocation and task progress for each subject carrying out rescue work at the same time. The generation of the dispatch plan depends on the real-time basic data collection, the monitoring of rescue operation conditions, the execution process of each sub-task, and unexpected obstacles. The whole process forms a closed loop of perception-decision-execution-feedback, so the global dispatch command It is difficult to accomplish purely based on subjective experience.

It is necessary to comprehensively consider the spatial structure information of underwater accident objects and the interference of complex environmental conditions (low visibility, fast water flow, cold water temperature, etc.) and other factors that restrict the efficiency of emergency rescue. Through the comprehensive use of multi-source sensor equipment to quickly detect underwater space, realize the dynamic perception of the spatial structure layout of the accident main body and the rescue target position, establish a spatial perception model, and use the expert system and past rescue cases to formulate the dispatching system of multiple rescue forces. Scientific and reasonable the rescue plan can reduce the difficulty of rescue and improve the efficiency of rescue.

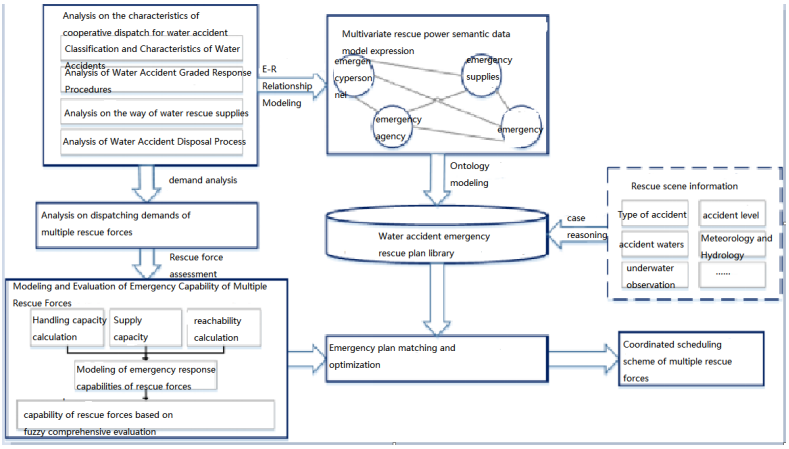

Figure 1. The realization principle of the intelligent generation and evaluation of the collaborative dispatch scheme of multiple rescue forces

4.2 Information Process Design of Coordinated Dispatching System of Multiple Rescue Forces

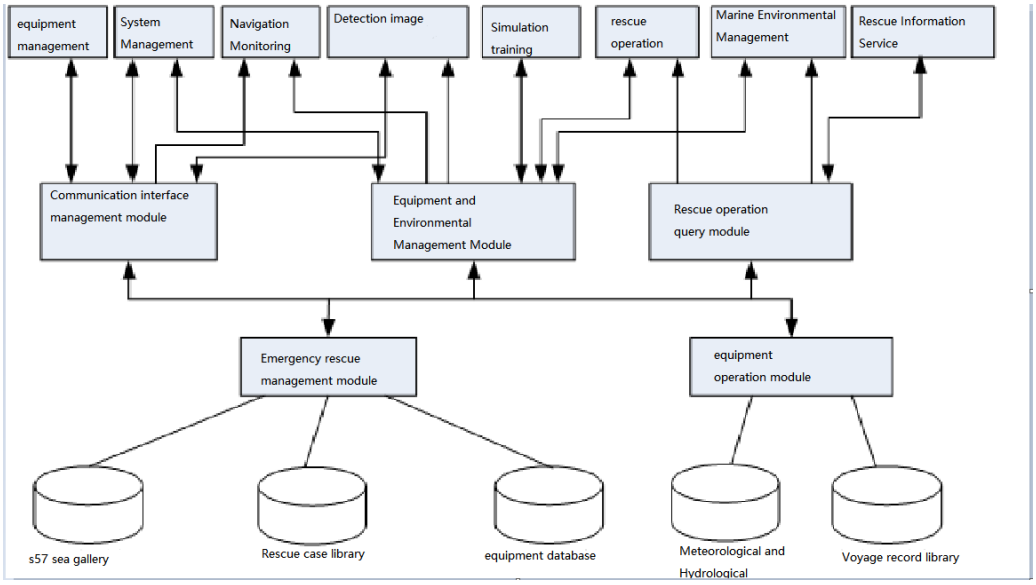

Figure 2. The information flow chart of the coordinated dispatching system of multiple rescue forces

The multi-function system includes various information, such as information from GPS, compass, depth sounder, log and other equipment of ships and aircraft; environmental information such as wind speed, wind direction, flow rate, and flow direction from other environmental sensors; rescue ships and underwater rescue operations such as track, course, speed and other status information; the position, quantity and status information of the rescued personnel; multi-data source electronic chart data, weather, sea state forecast information and various static information; radar video image data, Sonar detection image information.

The information flow of the coordinated dispatching system of multiple rescue forces is shown in Figure 2.

4.3 Design of Data Exchange Platform

4.3.1 System Architecture

First, each business system develops application programs according to its own system data structure, and uses common data standard specifications to generate XML files that meet the requirements of the data to be shared; then, the XML files are transmitted to the data exchange platform through the data acquisition interface module. In this way, the external system can query the data it needs in the platform's intermediate database through query requests, so as to achieve the purpose of data sharing. Below, makes a brief analysis of the four major parts of the data exchange system architecture [8].

Business system: It refers to each business system within the enterprise, which is responsible for converting the shared data of its own system into a standard XML file. It is a shared data provider and a shared data consumer.

External system: refers to the user system that needs to query shared data and has corresponding permissions.

Data acquisition module: It is an important part of the data exchange system, including the traditional acquisition interface and the Web Service interface. It collects the data to be transmitted and sends it to the data exchange platform for processing.

Data exchange platform: It is an important part of the data exchange system. It consists of the original data pool, the platform intermediate database and the core processing module. It is responsible for the processing and storage of XML files. Data acquisition module and data exchange platform are the core parts of the system to realize data sharing.

4.3.2 Data Exchange Platform

The data exchange platform is responsible for the transformation and storage of the transmitted XML files, including the original data pool, the core processing module and the intermediate database.

Raw data pool. It is a data buffer pool, which acts as a buffer between the acquisition module and the core processing module; it is responsible for classifying and temporarily storing the data collected from the data acquisition interface module in the form of XML, and processing it when the core processing module is idle. The front position of the exchange and storage module; the data is stored according to the classification of each business system, each business system has its own corresponding folder, and the XML file is temporarily stored in the folder. If there is an error in the process of acquiring the data, the error information will be packaged into an XML file and sent to the error feedback information subdirectory[9].

Core processing module. It is the center of data exchange, the link connecting the original data pool, database and external systems, responsible for XML data processing and database data conversion, including two functions:

The XML files transmitted from the original data pool are stored in the intermediate database according to the specified data structure.

According to the user's query request, the shared data processing of the required intermediate database is combined into an XML file and transmitted to the user for use.

This involves data conversion between XML files and databases. Since the data in the original data pool is sent to the platform intermediate database in the form of XML documents, if the entire document is stored in the database intact, it will cut off the connection between the data and the data, and it is difficult to manage and maintain. Therefore, what is used in the data exchange platform is split according to the structure level of XML documents, and they are stored in different tables or fields.

Intermediate database. It is where the shared data uploaded by the business system is centrally stored, and is the shared data processed by the core processing module.

As long as each business system provides its own data according to a certain general format such as XML, there is no need to change the original database structure. The intermediate database facilitates online retrieval and is easy to operate. This approach enables each business system to have complete control over its own data. If the user needs to query information, the corresponding data information will be fetched from the intermediate database, and processed from the database structure to the XML file by the core processing module, and the XML file will be transmitted to the user, processed and displayed in the user's system.

The data table of the intermediate database is divided into two categories: basic code table and user table. The code table is used to maintain basically unchanged data in the system, including gender, ethnicity, position, country, submission method, settlement result, special procedure type, special procedure result, etc. The user table is used to maintain the data frequently operated by the user, mainly including the applicant information table, the application company information table, the acceptance information table, the business information table, the business rule information table, the supply information table, the approval information table, the manager Information sheet, settlement information sheet, special procedure information sheet, etc.

5. Research Findings and Conclusions

5.1 System Collaborative Planning and Design

This project plans to adopt the multi-department coordination method of emergency resources of hierarchical task network. The method can realize the alternate development of the emergency rescue plan planning process and the coordination process of each rescue force, and avoid the repeated invocation planning of the existing distributed multi-agent system and the generation of a large number of useless plans [10]. The multi-department coordination method of emergency resources of hierarchical task network In the process of local plan planning, each atomic action is generated, and coordination with other departments is carried out to improve the generation efficiency of the overall plan, avoid conflicts between related emergency resources during the processing of tasks, and ensure that Collaborative use of emergency resources.

5.2 System Information Process Design

The information required for various water rescues is managed by five modules, namely communication interface management module, equipment and environment management module, rescue operation query module, equipment operation module, and emergency rescue management module. The five modules contain The information involves all aspects of water rescue, which can provide information support for water rescue more comprehensively, reduce the interference of water uncertain factors on rescue, and analyze the feasibility of the plan for organizing and dispatching various rescue forces to obtain the most suitable dispatch plan.

5.3 Data Exchange System Structure Design

According to the relevant literatures found, the existing data exchange platform design ideas are analyzed. This project plans to divide the data exchange platform into three parts: external system, data acquisition module, and data exchange platform. The external system is Each business system provides real-time query and reception of various data for different rescue forces, and generates

unified XML file data for the information to be shared and sends it to the data acquisition module. The information is collected and sent to the data exchange platform. The data exchange platform consists of three parts. The original data pool is used for short-term storage of data. When the core processing module is idle, the processing is called out. The core processing module is used for data processing and database data conversion. , an intermediate database for centralized storage of various shared data.

6. Conclusion

In recent years, the number of water traffic accidents has been running at a high level. The organization and dispatching system based on the multi-force rescue on water designed by the author makes the safety performance higher through the efficient on-site command system. The multi-customer feedback system and real-time database system make the overall task execution time shorter. The overall task completion quality is higher and the overall resource consumption is reduced.

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